NITROGEN15 IN BIOLOGICAL RESEARCH

A Preliminary List of References to 1 August 1951 Compiled by

Eleanor Johnson

Washington, D. C. 1 November 1951

NITROGEN15 IN BIOLOGICAL RESEARCH

Introduction

This list of references is not to be considered comprehensive. It is entitled a "preliminary" list because it could serve as a basis for a more extended bibliography, although at present there are no plans for supplementing it. It was compiled from the following sources:

Nuclear Science Abstracts, v. 1-5, 1948-1951
Chemical Abstracts, 1937-1948
Journal of Biological Chemistry, Jan.-June 1951
Current List of Medical Literature, July 1950June 1951
Index-Catalogue of the Library of the Surgeon
General's Office, Unprinted Card Supplement
Army Medical Library Subject Card Catalogue
Siri, W. E. Isotopic tracers and nuclear radiations. No You McGraw-Hill, 1949.

The references were not checked for any additional pertinent material they might cite. Since nitrogen¹⁵ is a "tool" which can be used in many types of biological research, it has seemed that any comprehensive list of references should be confined to some particular aspect of its use.

With the exception of several general review articles cited at the beginning of the list, references are arranged chronologically with the most recent years first, and arrangement within a year is alphabetical by author.

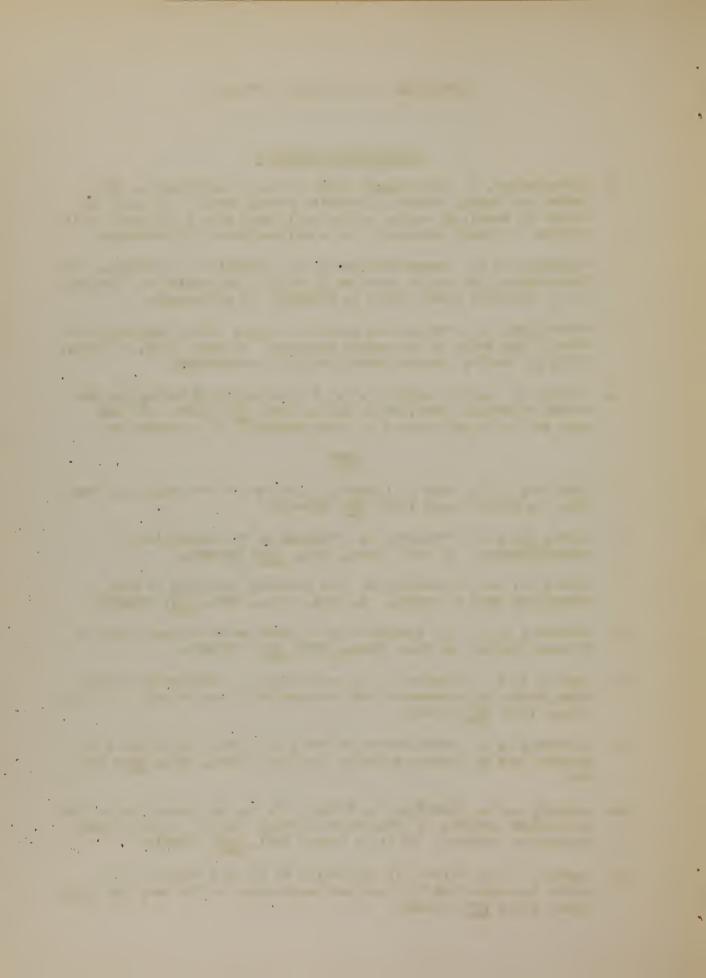
> Arch. = 5524 9765711

NITROGEN 15 IN BIOLOGICAL RESEARCH

Comprehensive Reviews

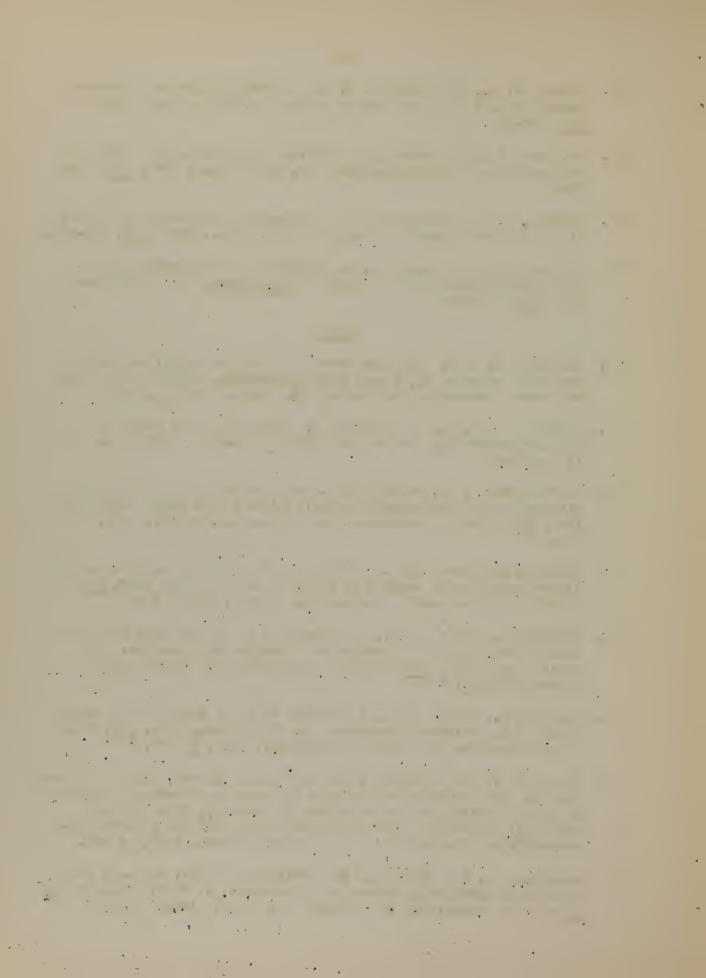
- 1. Schoenheimer, R. The dynamic state of body constituents. 81 p. Cambridge, Mass., Harvard University Press, 1942. This book includes an excellent review of the early work with biological applications of "heavy nitrogen", and a well-selected bibliography.
- 2. Sprinson, D. B. Tracer studies on the metabolism of proteins. In: Symposium on the use of isotopes in biology and medicine. Madison, U. of Wisconsin Press, 1948. p. 182-208. 41 references.
- 3. Vennesland, R. Nitrogen and carbon isotopes: their application in vivo to the study of the animal organism. Advance. Biol. M. Phys., 1948, 1: 45-116. Review article with 200 references.
- 4. Wilson, P. W., and Burris, R. H. The mechanism of biological nitrogen fixation. Bact. Rev., Balt., 1947, 11: 41-73. N¹⁵ was used as the tracer element in these studies. 117 references.

- 5. Bidinost, L. E. Rate of formation of myosin in the muscle of the rat. J. Biol. Chem., 1951, 190: 423-430.
- 6. Clark, I., and Rittenberg, D. Evidence on the metabolism of a-acetyllysine. J. Biol. Chem., 1951, 189: 529-531.
 - 7. Clark, I., and Rittenberg, D. The metabolic activity of the a-hydrogen atom of lysine. J. Biol. Chem., 1951, 189: 521-528.
 - 8. Delwiche, C. C. The assimilation of ammonium and nitrate ions by tobacco plants. J. Biol. Chem., 1951, 189: 167-175.
 - 9. Fruton, J. S., Johnston, R. B., and Fried, M. Elongation of peptide chains in enzyme-catalyzed transamidation reactions. J. Biol. Chem., 1951, 190: 39-53.
 - 10. Hoberman, H. D. Measurements of rates of protein degradation and protein loss in fasting animals. J. Biol. Chem., 1951, 188: 797-804.
 - 11. Kozloff, L. M., Knowlton, K., Putnam, F. W., and Evans, E. A., Jr. Biochemical studies of virus reproduction. V. The origin of bacteriophage nitrogen. J. Biol. Chem., 1951, 188: 101-116.
 - 12. Marrian, D. H., Spicer, V. L., Balis, M. E., and Brown, G. B.
 Purine incorporation into pentose nucleotides of the rat. J. Biol.
 Chem., 1951, 189: 533-541.



- 13. Meneghini, N., and Delwiche, C. C. The multiplication of tobacco mosaic virus in the host tobacco plant. J. Biol. Chem., 1951, 189: 177-186.
- 14. Reichard, P., and Estborn, B. Utilization of desoxyribosides in the synthesis of polynucleotides. J. Biol. Chem., 1951, 188: 839-846.
- 15. Stetten, M. R. Mechanism of the conversion of ornithine into proline and glutamic acid in vivo. J. Biol. Chem., 1951, 189: 499-507.
- 16. Yanofsky, C., and Bonner, D. M. Studies on the conversion of 3-hydroxyanthranilic acid to miacin in Neurospora. J. Biol. Chem., 1951, 190: 211-218.

- 17. Arnstein, H. R. V. The biosynthesis of choline methyl groups in the rat. Biochem. J., Lond., 1950, 47: xviii-xix. N15-labeled glycine was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 894.
- 18. Arnstein, H. R. V., and Bentley, R. Isotopes in the study of chemical reactions. Nucleonics, 1950, 6: 11-27. Material on N¹⁵ is included.
- 19. Bartholomew, W. V., Nelson, L. B., and Werkman, C. H. The use of nitrogen isotope nitrogen 15 in field studies with oats. Agron. J., 1950, 42: 100-103. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 645.
- 20. Bendich, A., Brown, G. B., Philips, F. S., and Thiersch, J. B. The direct oxidation of adenine in vivo. J. Biol. Chem., 1950, 183: 267-277. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 516.
- 21. Bendich, A., Furst, S. S., and Brown, G. B. On the role of 2, 6-diaminopurine in the biosynthesis of nucleic acid guanine. J. Biol. Chem., 1950, 185: 423-433. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 775.
- 22. Bendich, A., Geren, W. D., and Brown, G. B. A study of the metabolism of 2, 4-diaminopyrimidine. J. Biol. Chem., 1950, 185: 435-438. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 777.
- 23. Benedict, J. D., Forsham, P. H., Roche, M., Soloway, S., and Stetten, D., Jr. The effect of salicylates and adrenocorticotropic hormone upon the miscible pool of uric acid in gout. J. Clin. Invest., 1950, 29: 1104-1111. Uric acid labeled with N15 was injected intravenously. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 894.
- 24. Berenbom, M., and White, J. The metabolism of intravenously administered ammonium glutamate and glutamine. J. Biol. Chēm., 1950, 182: 5-10. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 359.

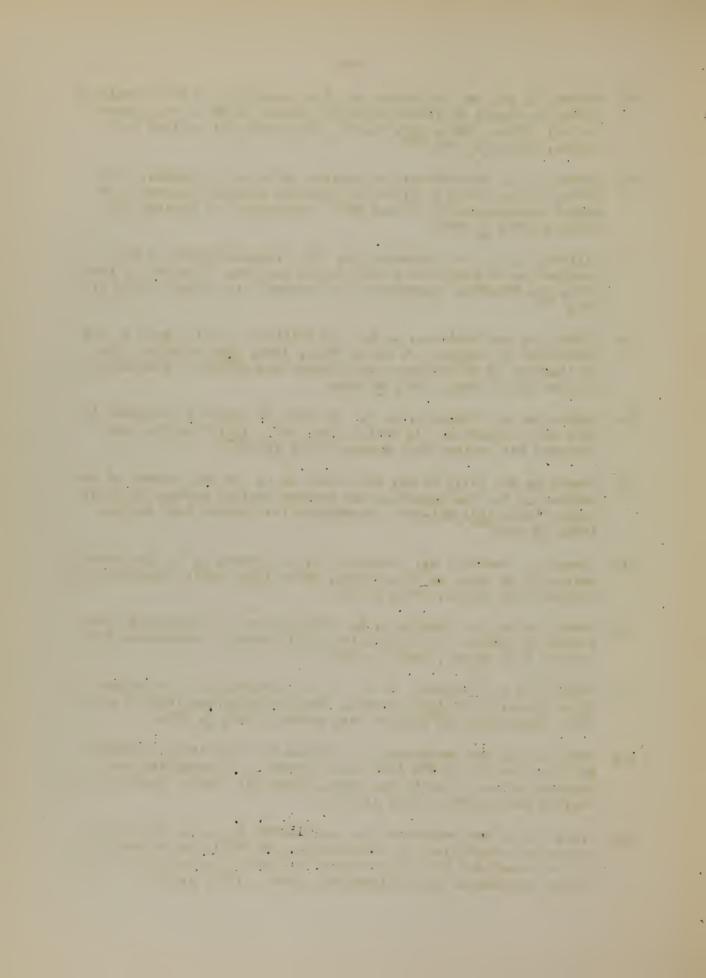


- 25. Bonner, D. M., and Wasserman, E. The conversion of N¹⁵-containing indole to niacin by niacin-requiring strain 39401 of Neurospora.

 J. Biol. Chem., 1950, 185: 69-74. Abstracted in: Nuclear Sci.

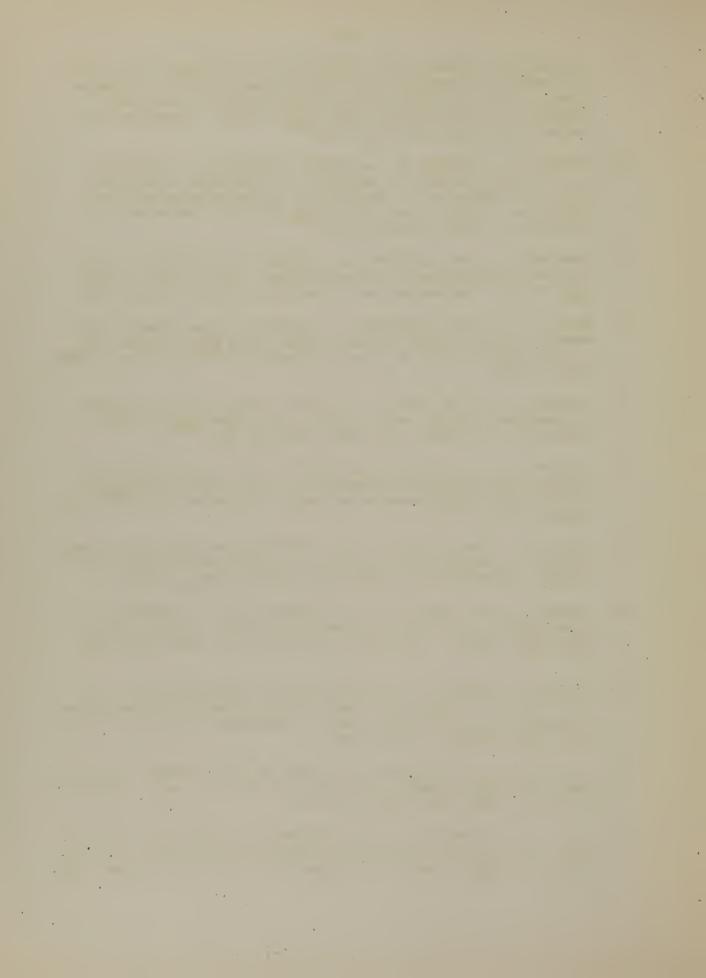
 Abstr., 1950, 4: 772.
- 26. Brown, G. B. Biosynthesis of nucleic acids in the mammal. Fed. Proc., Balt., 1950, 9: 517-523. Includes general discussion of recent research using Cl4 and Nl5. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 894.
- 27. Elliott, D. F., and Neuberger, A. The irreversibility of the deamination of threonine in the rabbit and rat. Biochem. J. Lond., 1950, 46: 207-210. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 564.
- 28. Elwyn, D., and Sprinson, D. B. The relation of folic acid to the metabolism of serine. J. Biol. Chem., 1950, 184: 475-478. The utilization of N¹⁵-L-serine and glycine was studied. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 689.
- 29. Elwyn, D., and Sprinson, D. B. The role of serine and acetate in uric acid formation. J. Biol. Chem., 1950, 184: 465-474. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 690.
- 30. Furst, S. S., Roll, P. M., and Brown, G. B. On the renewal of the purines of the desoxypentose and pentose nucleic acids. J. Biol. Chem., 1950, 183: 251-266. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 462.
- 31. Geren, W., Bendich, A., Bodansky, O., and Brown, G. B. The fate of uric acid in man. J. Biol. Chem., 1950, 183: 21-31. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 517.
- 32. Ghosh, B. P., and Burris, R. H. Utilization of nitrogenous compounds by plants. Soil Sci., 1950, 70: 187-203. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 898.
- 33. Graff, J., and Hoberman, H. D. On the metabolism of B-alanine. J. Biol. Chem., 1950, 186: 369-372. The B-alanine was labeled with N15. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 896.
- 34. Gray, C. H., and Neuberger, A. Studies in congenital porphyria.

 1. Incorporation of 15N into coproporphyrin, uroporphyrin and hippuric acid. Biochem. J., Lond., 1950, 47: 81-87. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 837.
- 35. Gray, C. H., and Neuberger, A., and Sneath, P. H. A. Studies in congenital porphyria. 2. Incorporation of 15N in the stercobilin in the normal and in the porphyric. Biochem. J., Lond., 1950, 47: 87-92. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 837.

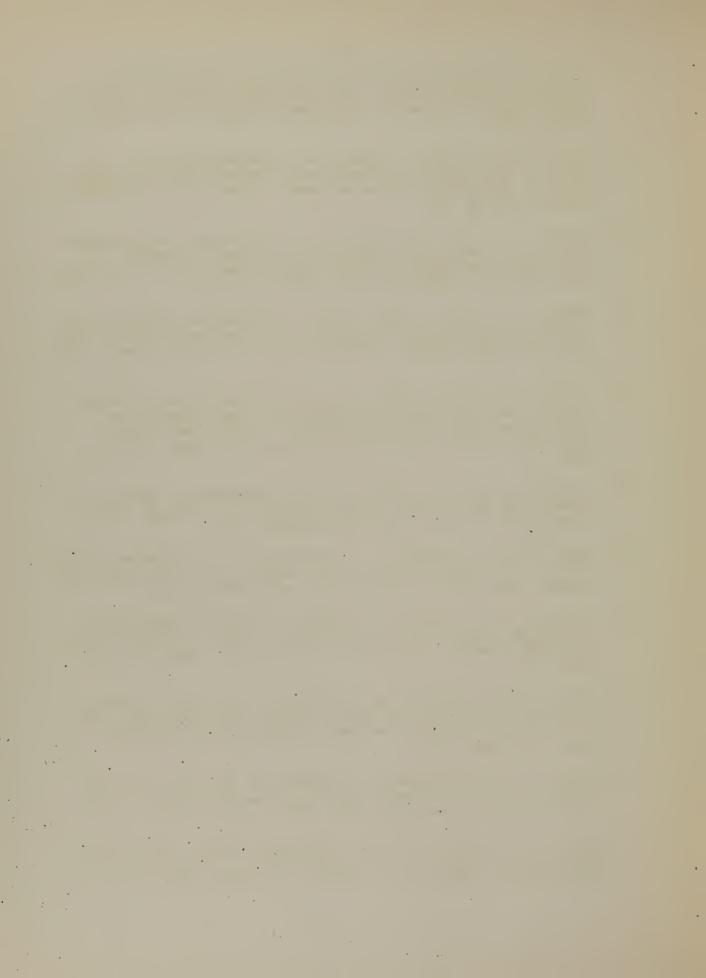


- 36. Grinstein, M., Kamen, M. D., Wikoff, H. N., and Moore, C. V. Isotopic studies of porphyrin and hemoglobin metabolism. I. Biosynthesis of coproporphyrin I and its relationship to hemoglobin metabolism. J. Biol. Chem., 1950, 182: 715-721. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 358.
- 37. Grinstein, M., Wikoff, H. M., Pimenta de Mello, R., and Watson, C. J. Isotopic studies of porphyrin and hemoglobin metabolism. II. The biosynthesis of coproporphyrin III in experimental lead poisoning. J. Biol. Chem., 1950, 182: 723-726. Abstracted in: Nuclear Sci. Abstr., 1950; 4: 358.
- 38. Hammarsten, E., and Reichard, P. Pyrimidine nucleosides as precursors of pyrimidines in polynucleotides. J. Biol. Chem., 1950, 183: 105-109. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 519.
- 39. Hirs, C. H. W., and Rittenberg, D. Studies on urea formation in surviving liver slices. J. Biol. Chem., 1950, 186: 429-445. N15 of the ornithine cycle was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 959.
- 40. Hoberman, H. D., and Fruton, J. S. The metabolic fate of acetyl-dehydrotyrosine in the rat. J. Biol. Chem., 1950, 182: 127-129.

 Abstracted in: Nuclear Sci. Abstr., 1950, 4: 359.
- 41. Hoberman, H. D., and Graff, J. Effects of fasting of glucose ingestion on the retention of ammonia. J. Biol. Chem., 1950, 186: 373-375. N15 labeled ammonia was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 894.
- 42. Hultin, T. Incorporation in vivo of N¹⁵-labeled glycine into liver fractions of newly hatched chicks. Exp. Cell Research, 1950, 1: 376-381. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 895.
- 43. Johnston, R. B., Mycek, M. J., and Fruton, J. S. Catalysis of transamidation reactions by proteolytic enzymes. J. Biol. Chem., 1950, 185: 629-641. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 834.
- 44. Leifer, E., Langham, W. H., Nyc, J. F., and Mitchell, H. K. The use of isotopic nitrogen in a study of the conversion of 3-hydroxy-anthranilic acid to nicotinic acid in Neurospora. J. Biol. Chem., 1950, 184: 589-592. 8 references.
- 45. London, I. M. The conversion of hematin to bile pigment. J. Biol. Chem., 1950, 184: 373-376. N15-labeled hematin was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 598.
- 46. London, I. M., Shemin, D., and Rittenberg, D. Synthesis of heme in vitro by the immature nonnucleated mammalian erythrocyte. J. Biol. Chem., 1950, 183: 749-755. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 566.

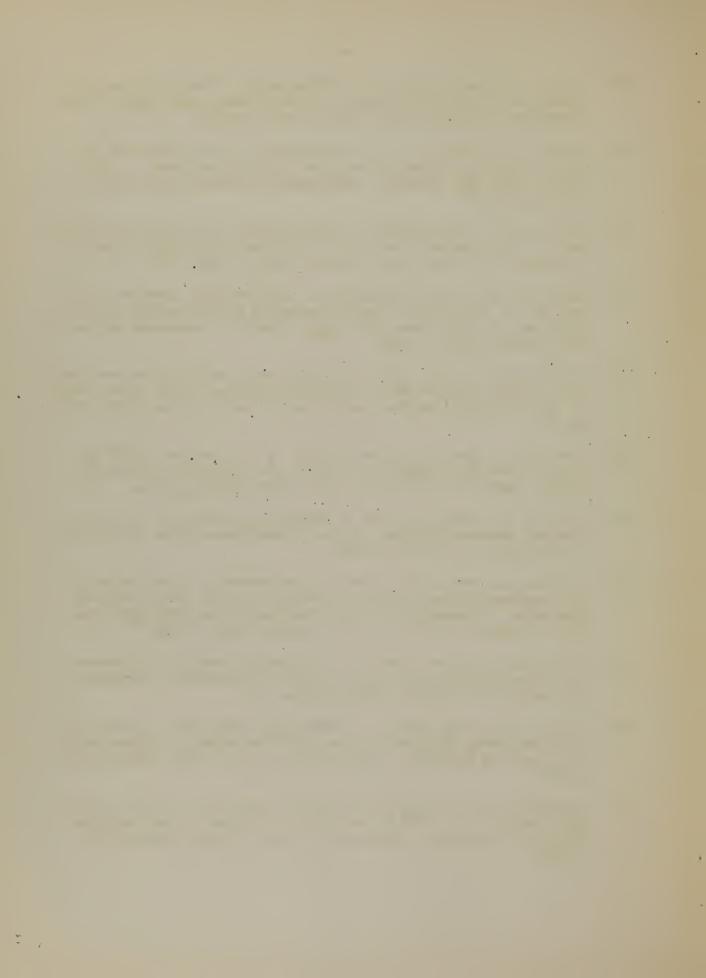


- 47. London, I. M., and West, R. The formation of bile pigment in pernicious anemia. J. Biol. Chem., 1950, 184: 359-364. Glycine labeled with N15 was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 598.
- 48. London, I. M., West, R., Shemin, D., and Rittenberg, D. On the origin of bile pigment in normal man. J. Biol. Chem., 1950, 184: 351-358. N15-labeled glycine was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 600.
- 49. London, I. M., West, R., Shemin, D., and Rittenberg, D. Porphyrin formation and hemoglobin metabolism in congenital porphyria. J. Biol. Chem., 1950, 184: 365-371. Glycine labeled with N¹⁵ was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 600.
- 50. Maynert, E. W., and Van Dyke, H. B. The absence of localization of barbital in divisions of the central nervous system. J. Pharm. Exp. Ther., 1950, 98: 184-187. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 641.
- 51. Maynert, E. W., and Van Dyke, H. B. The metabolic fate of pento-barbital; isotope dilution experiments with urine after the administration of labeled pentobarbital. J. Pharm. Exp. Ther., 1950, 98: 174-176. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 359.
- 52. Maynert, E. W., and Van Dyke, H. B. The metabolism of amytal labeled with N15 in dogs. J. Pharm. Exp. Ther., 1950, 98: 180-183. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 359.
- 53. Muir, H. M., and Neuberger, A. The biogenesis of porphyrins. 2. The origins of the methyne carbon atoms. Biochem. J., Lond., 1950, 47: 97-104. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 834.
- 54. Muntz, J. A. The inability of choline to transfer a methyl group directly to homocysteine for methionine formation. J. Biol. Chem., 1950, 182: 489-499. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 357.
- 55. Radin, N. S., Rittenberg, D., and Shemin, D. The role of acetic acid in the biosynthesis of heme. J. Biol. Chem., 1950, 184: 755-767. N¹⁵ labeled glycine was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 690.
- 56. Radin, N. S., Rittenberg, D., and Shemin, D. The role of glycine in the biosynthesis of heme. J. Biol. Chem., 1950, 184: 745-753. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 690.
- 57. Shemin, D. The biosynthesis of porphyrins. Sympos. Quant. Biol., Cold Spring Harbor, N. Y., 1948, 13: 185-192. Glycine labeled with N15 was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 356.

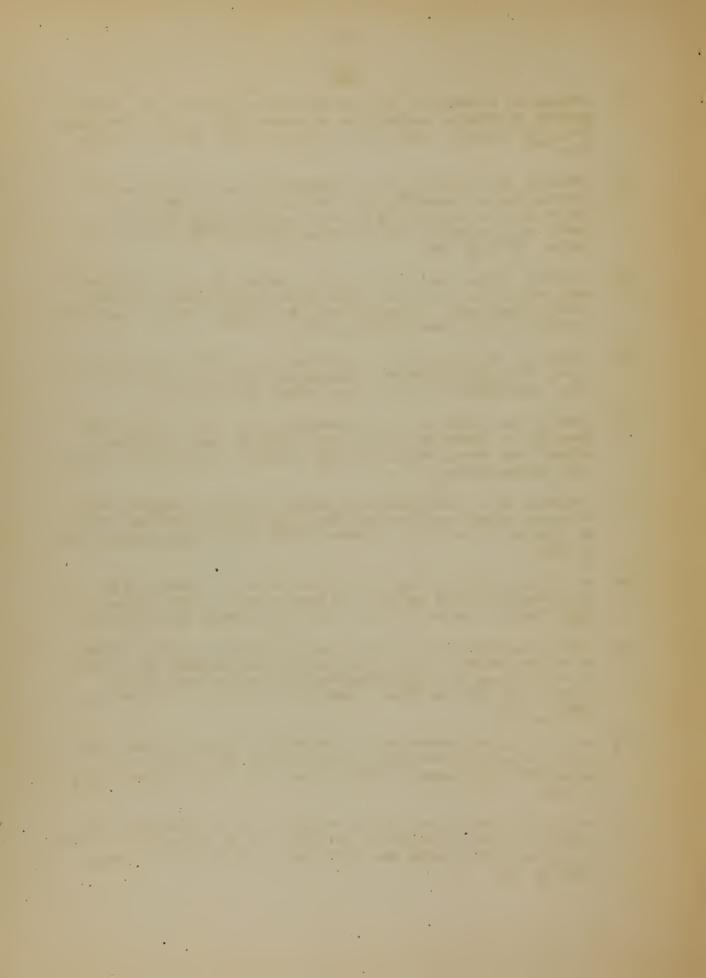


- 58. Shemin, D., London, I. M., and Rittenberg, D. The relationship of serine to porphyrin synthesis. J. Biol. Chem., 1950, 183: 767-769. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 565.
- 59. Shemin, D., London, I. M., and Rittenberg, D. The synthesis of protoporphyrin in vitro by red blood cells of the duck. J. Biol. Chem., 1950, 183: 757-765. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 566.
- 60. Simmonds, S. The metabolism of phenylalanine and tyrosine in mutant strains of Escherichia coli. J. Biol. Chem., 1950, 185: 755-762.

 Abstracted in: Nuclear Sci. Abstr., 1950, 4: 836.
- 61. Sprinson, D. B., and Rittenberg, D. The metabolic activity of the a-, B-, and Y- hydrogen atoms of L-leucine and the a-hydrogen of glycine. J. Biol. Chem., 1950, 184: 405-416. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 599.
- 62. Stetten, D., Jr. The pool of miscible uric acid in normal and gouty man, studied with the aid of isotopic nitrogen. J. Mt. Sinai Hosp., N. Y., 1950, 17: 149-158. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 959.
- 63. Tove, S. R., Niss, H. F., and Wilson, P. W. Fixation of N25 by excised nodules of leguminous plants. J. Biol. Chem., 1950, 184: 77-82. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 598.
- 64. Uber, F. M. Stable isotopes as tracers. In: Uber, F. M. Bio-physical research methods. N. Y., Interscience, 1950. p. 561-598. A discussion of N15 is included.
- 65. Waelsch, H., Owades, P., Borek, E., Grossovicz, N., and Schow, M. The enzyme-catalyzed exchange of ammonia with the amide group of glutamine and asparagine. Arch. Biochem., N. Y., 1950, 27: 237-239. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 726.
- 66. White, A. G. C., and Parson, W. Comparative studies on nitrogen excretion. Arch. Biochem., N. Y., 1950, 26: 205-208. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 563.
- 67. Wood, H. G., and Lorber, V. Carbohydrate metabolism. Annual Rev. Biochem., 1949, 18: 299-334. Use of N15 to study the tricarboxylic acid cycle is reported. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 724.
- 68. Zamecnik, P. C., and Aub, J. Growth. Annual Rev. Physiol., 1950, 12: 71-100. Use of N15 in the study of peptide and protein synthesis is mentioned. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 726.



- 69. Abrams, R., Hammersten, E., Reichard, P., and Sperber, E. Tracer studies of nitrogen assimilation in yeast. II. J. Gen. Physiol., 1949, 32: 271-277. Abstracted in: Nuclear Sci. Abstr., 1949, 3: 486.
- 70. Arvidson, H., Eliasson, N. A., Hammarsten, E., Reichard, P., von Ubisch, H., and Bergstrom, S. Orotic acid as a precursor of pyrimidines in the rat. J. Biol. Chem., 1949, 179: 169-173. Orotic acid containing N15 was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 104.
- 71. Benedict, J. D., Forsham, P. H., and Stetten, D. The metabolism of uric acid in the normal and gouty human studied with the aid of isotopic uric acid. J. Biol. Chem., 1949, 181: 183-193. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 61.
- 72. Bloch, K. The synthesis of glutathione in isolated liver. J. Biol. Chem., 1949, 179: 1245-1254. DL-glutamic acid was labeled with N15. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 106.
- 73. Borsock, H., Deasy, C. L., Haagen-Smit, A. J., Keighley, G., and Lowy, P. H. Uptake of labeled amino acids by tissue proteins in vitro. Fed. Proc., Balt., 1949, 8: 589-596. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 223.
- 74. Davidson, J. N. Nucleoproteins, nucleic acids, and derived substances. Annual Rev. Biochem., 1949, 18: 155-190. The use of N15 as a tracer is mentioned. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 727.
- 75. Di Carlo, F. J., Schultz, A. S., Roll, P. M., and Brown, G. B.
 Isotopically labeled nucleic acid from yeast. J. Biol. Chem., 1949,
 180: 329-331. Abstracted in: Nuclear Sci. Abstr., 1949, 3: 318.
- 76. Getler, H., Roll, P. M., Tinker, J. F, and Brown, G. B. A study of the metabolism of dietary hypoxanthine and xanthine in the rate J. Biol. Chem., 1949, 178: 259-264. Hypoxanthine and xanthine labeled with N15 were used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 161.
- 77. Gray, C. H., and Neuberger, A. Investigations on porphyrin formation in congenital porphyria with the aid of N15. Biochem. J., Lond., 1949, 44: xlv-xlvi. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 462.
- 78. Gray, C. H., Neuberger, A., and Sneath, P. H. A. Stercobilin formation in a case of congenital porphyria and in the normal. Biochem. J., Lond., 1949, 45:xvi. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 601.



- 79. Grinstein, M., Aldrich, R. A., Hawkinson, V., and Watson, C. J. An isotopic study of porphyrin and hemoglobin metabolism in a case of porphyria. J. Biol. Chem., 1949, 179: 983-984. Abstracted in: Nuclear Sci. Abstr., 1949, 3: 148.
- 80. London, I. M., Shemin, D., West, R., and Rittenberg, D. Heme synthesis and red blood cell dynamics in normal humans and in subjects with polycythemia vera, sickle-cell anemia, and pernicious anemia. J. Biol. Chem., 1949, 179: 463-484. Glycine labeled with N15 was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 101.
- 81. McKee, H. S. Review of recent work on nitrogen metabolism. New Phytologist, 1949, 48: 1-83. Use of N¹⁵ in tracer studies is reported. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 520.
- Muir, H. M., and Neuberger, A. The biogenesis of porphyrins; the distribution of 15N in the ring system. Biochem. J., Lond., 1949, 45: 163-170. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 597.
- 83. Muir, H. M., and Neuberger, A. Further studies of the biogenesis of porphyrins in rabbits. Biochem. J., Lond., 1949, 45: xxxiv. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 598.
- 84. Neuberger, A. Metabolism of proteins and amino acids. Annual Rev. Biochem., 1949, 18: 243-266. Reports on the use of N¹⁵ are included. Earlier volumes in the "Annual Review" series also include brief reports on this topic.
- 85. Reichard, P. On the nitrogen turnover in purines from polynucleotides determined with glycine N¹⁵. J. Biol. Chem., 1949, 179: 773-781. Abstracted in: Nuclear Sci. Abstr., 1949, 3: 149.
- 86. Reichard, P. On the turnover of purines and pyrimidines from polynucleotides in the rat determined with N15. Acta chem. scand., 1949, 3: 422-432. Abstracted in: Nuclear Sci. Abstr., 1949, 3: 385.
- 87. Roll, P. M., Brown, G. B., di Carlo, F., and Schultz, A. S. The metabolism of yeast nucleic acid in the rat. J. Biol. Chem., 1949, 180: 335-340. Yeast nucleic acid labeled with N15 was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 598.
- 88. Rosenblum, E. D., and Wilson, P. W. Fixation of isotopic nitrogen by clostridium. J. Bact., Balt., 1949, 57: 413-414. Abstracted in: Nuclear Sci. Abstr., 1949, 3: 17.
- 89. Sprinson, D. B., and Rittenberg, D. The rate of interaction of the amino acids of the diet with the tissue proteins. J. Biol. Chem., 1949, 180: 715-726. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 601.
- 90. Sprinson, D. B., and Rittenberg, D. The rate of utilization of ammonia for protein synthesis. J. Biol. Chem., 1949, 180: 707-714.

 Ammonium citrate of high N15 concentration was used. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 105.

- 91. Stetten, M. R. Some aspects of the metabolism of hydroxyproline, studied with the aid of isotopic nitrogen. J. Biol. Chem., 1949, 181: 31-37. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 62.
- 92. U. S. Atomic Energy Commission. Isotopes, a three-year summary of distribution with extensive bibliography. Washington, G. P. O., 1949. The 100 page bibliography includes references on N15.
- 93. Wittenberg, J., and Shemin, D. The utilization of glycine for the biosynthesis of both types of pyrroles in protoporphyrin. J. Biol. Chem., 1949, 178: 47-51. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 162.
- 94. Wu, H., and Rittenberg, D. Metabolism of L-aspartic acid. J. Biol. Chem., 1949, 179: 847-856. L-aspartic acid was synthesized from fumaric acid ammonia containing N15. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 103.

- 95. Abrams, R., Hammarsten, E., and Shemin, D. Glycine as a precursor of purines in yeast. J. Biol. Chem., 1948, 173: 429-430. N15 was used in the study. Abstracted in: Chem. Abstr., 1948, 42: 4235.
- 96. Ashby, W. The span of life of the red blood cell; a resume. Blood, N. Y., 1948, 3: 486-500. Experiments determining life span by labeling corpuscles with N¹⁵ are discussed. Abstracted in: Nuclear Sci. Abstr., 1948, 1: 107.
- 97. Bendich, A., and Brown, G. B. 2, 6-Diaminopurine, a precursor of nucleic acid guanine. J. Biol. Chem., 1948, 176: 1571-1572. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 162.
- 98. Bergstrand, A., Eliasson, N. A., Hammarsten, E., Norberg, B., Reichard, P., and von Ubisch, H. Experiments with N15 on purines from muclei and cytoplasm of normal and regenerating liver. Sympos. Quant. Biol., Cold Spring Harbor, N. Y., 1948, 13: 22-25. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 357.
- 99. Brown, G. B. Studies of purine metabolism. Sympos. Quant. Biol., Cold Spring Harbor, N. Y., 1948, 13: 43-51. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 362.
- 100. Brown, G. B., Roll, P. M., Plentl, A. A., and Cavalieri, L. F. Utilization of adenine for nucleic acid synthesis and as a precursor of guanine. J. Biol. Chem., 1948, 172: 469-484. Adenine containing excess N15 was used. Abstracted in: Chem. Abstr., 1948, 42: 3785.
- 101. Cavalieri, L. F., Blair, V. E., and Brown, G. B. The synthesis of uric acid containing isotopic nitrogen. J. Am. Chem. Soc., 1948, 70: 1240-1242. Abstracted in: Chem. Abstr., 1948, 42: 7251.

-10-

- 102. Davidson, J. N., and Reymond, W. Nucleic acids labelled with P³² and Nl⁵. Biochem. J., Lond., 1948, 42: XIV. Abstracted in: Nuclear Sci. Abstr., 1948, 1: 111.
- 103. Grinstein, M., Kamen, M. D., and Moore, C. V. Studies on globin and porphyrin metabolism made with Cl4 and Nl5. J. Laborat. Clin. M., 1948, 33: 1478-1479. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 160.
- MacVicar, R., and Burris, R. H. Translocation studies in tomato using ammonium sulfate labeled with N15. Am. J. Bot., 1948, 35: 567-570. Abstracted in: Nuclear Sci. Abstr., 1949, 2: 199.
- 105. Muir, H. M., and Neuberger, A. Investigations on porphyrin formation in rabbits with the aid of N15. Biochem. J., Lond., 1948, 43: 1x. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 462.
- 106. Shemin, D., London, I. M., and Rittenberg, D. The in vitro synthesis of home from glycine by the nucleated red blood cells J. Biol. Chem., 1948, 173: 799-800. Glycine labeled with N¹⁵ was used. Abstracted in: Nuclear Sci. Abstr., 1948, 1: 106.
- 107. Terry, R., Sandrock, W. E., Nye, R. E., Jr., and Whipple, G. H. Parenteral plasma protein maintains nitrogen equilibrium over long periods. J. Exp. M., 1948, 87: 547-559. Lysine labeled with N15 was used. Abstracted in: Nuclear Sci. Abstr., 1948, 1: 107.
- 108. Tove, S. R., and Wilson, P. W. Isotopic studies of fixation by rhizobia in presence of hemoprotein. Proc. Soc. Exp. Biol., N. Y., 1948, 69: 184-186. Abstracted in: Nuclear Sci. Abstr., 1950, 4: 409.
- 109. Vigneaud, V. du. Migration of the methyl group in the body. Proc. Am. Phil. Soc., 1948, 92: 127-135. N¹⁵ was used in the study. Abstracted in: Chem. Abstr., 1948, 42: 8904.
- 110. White, A., Hoberman, H. D., and Szego, C. M. Influence of adrenal-ectomy and fasting on the incorporation of isotopic nitrogen into the tissues of mice. J. Biol. Chem., 1948, 174: 1049-1050. Abstracted in: Chem. Abstr., 1948, 42: 8286.

- 111. Brown, G. B., Roll, P. M., and Cavalieri, L. F. The in vivo oxidation of uric acid. J. Biol. Chem., 1947, 171: 835. The studies used isotopic N. Abstracted in: Chem. Abstr., 1948, 42: 2011.
- 112. Butler, G. C. Tracers in biology. Proc. Conf. Nuclear Chem., Chem. Inst. Can., Ottawa, 1947, 159-166. N15 is included. Abstracted in: Chem. Abstr., 1948, 42: 3444.
- 113. Kalckar, H. M. The biological synthesis of purine compounds. Symposia Soc. Exp. Biol., I. Nucleic Acid, 1947, 38-55. N15 was used in some of the studies. Abstracted in: Chem. Abstr., 1948, 42: 4207.

- 114. Kalckar, H. K., and Rittenberg, D. Rejuvenation of muscle adenylic acid nitrogen in vivo studied with isotopic nitrogen. J. Biol. Chem., 1947, 170: 455-459. Abstracted in: Chem. Abstr., 1948, 42: 1340.
- 115. London, I. M., Shemin, D., and Rittenberg, D. The application of the isotope technique to the study of the rates of formation of blood constituents in man. J. Clin. Invest., 1947, 26: 1188. Abstracted in: Nuclear Sci. Abstr., 1949, 2: 75.
- 116. McFarlane, A. S. Biochemical applications of stable and radioactive isotopes. Brit. M. J., 1947, 2: 766-768. Abstracted in: Nuclear Sci. Abstr., 1948, 1: 256.
- 117. Machata, H. A., Burris, R. H., and Wilson, P. W. Fixation of isotopic nitrogen by excised nodules. J. Biol. Chem., 1947, 171: 605-609.
- 118. Stoerk, H. C., John, H. M., and Eisen, H. N. Turnover of serum protein in adrenalectomized rats. Proc. Soc. Exp. Biol., N. Y., 1947, 66: 25-28. Rats were fed glycine laboled with N15. Abstracted in: Chem. Abstr., 1948, 42: 966.
- 119. Tesar, C., and Rittenberg, D. The metabolism of L-histidine. J. Biol. Chem., 1947, 170: 35-53. Isotopic L-histidine containing N15 was used. Abstracted in: Chem. Abstr., 1948, 42: 264.
- 120. Van Dyke, H. B., Scudi, J. V., and Tabern, D. L. The excretion of N15 in the urine of dogs after the administration of labeled pentobarbital. J. Pharm. Exp. Ther., 1947, 90: 364-366. Abstracted in: Nuclear Sci. Abstr., 1948, 1: 210.

121. Norman, A. G., and Krampitz, L. O. The nitrogen nutrition of soybeans. II. Effect of available soil nitrogen on growth and nitrogen fixation. Proc. Soil Sci. Soc. Am. (1945) 1946, 10: 191-196. N15 used to calculate amount of N fixed by soybeans. Abstracted in: Chem. Abstr., 1947, 41: 2518.

- 122. Shemin, D., and Rittenberg, D. Utilization of glycine for the synthesis of a porphyrin. J. Biol. Chem., 1945, 159: 567-568. Glycine containing excess N15 was used. Abstracted in: Chem. Abstr., 1945, 39: 4667.
- 123. Zeller, E. A., and Maritz, A. Fnzymic decomposition of monoaminodicarboxylic acids. Experientia, 1945, 1: 30. N15 was used in the feeding experiments. Abstracted in: Chem. Abstr., 1946, 40: 5079.



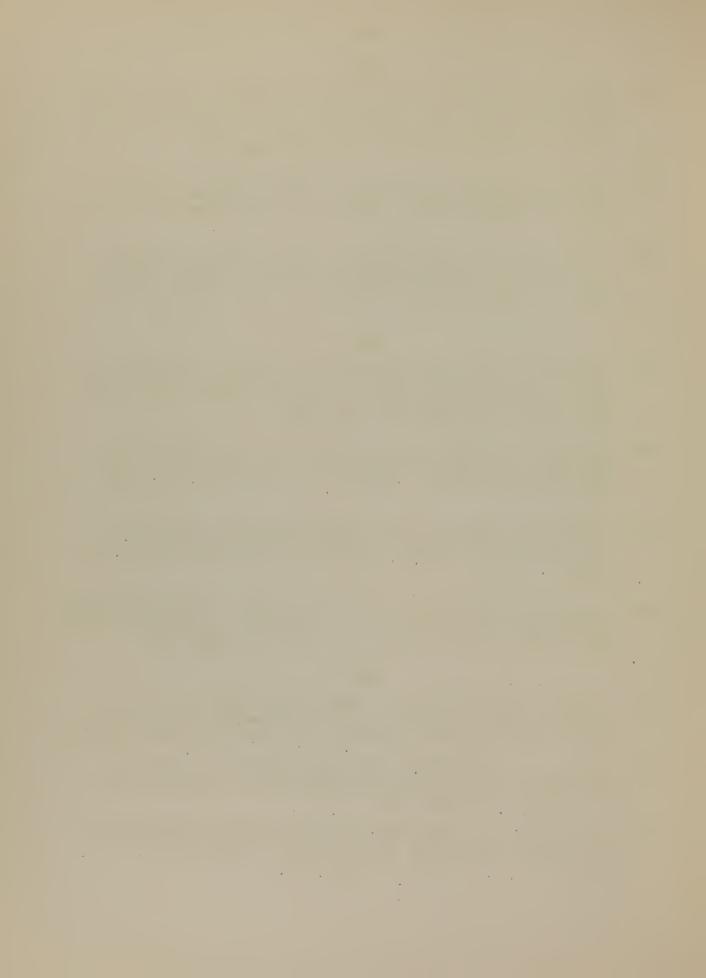
- 124. Fink, R. M., Enns, T., Kimball, C. P., and others. Plasma protein metabolism normal and associated with shock. Observations using protein labeled by heavy nitrogen in lysine. J. Exp. M., 1944, 80: 455-475. Abstracted in: Chem. Abstr., 1945, 39: 551.
- 125. Plentl, A. A., and Schoenheimer, R. Studies in the metabolism of purines and pyrimidines by means of isotopic nitrogen. J. Biol. Chem., 1944, 153: 203-217. Abstracted in: Chem. Abstr., 1944, 38: 3701.
- 126. Stetten, M. R., and Schoenheimer, R. The metabolism of 1-proline studied with the aid of deuterium and isotopic nitrogen. J. Biol. Chem., 1944, 153: 113-132. Abstracted in: Chem. Abstr., 1944, 38: 3700.

1943

- 127. Barnes, F. W., Jr., and Schoenheimer, R. Biological synthesis of purines and pyrimidines. J. Biol. Chem., 1943, 151: 123-139. Rats and pigeons were fed compounds marked with an excess of N15. Abstracted in: Chem. Abstr., 1944, 38: 1015.
- 128. Burris, R. N., Eppling, F. J., Wahlin, H. B., and Wilson, P. W. Biological N fixation with isotopic N. Proc. Soil Sci. Soc. Am., (1942) 1943, 7: 258-262. Abstracted in: Chem. Abstr., 1943, 37: 6803.
- 129. Burris, R. H., Eppling, F. J., Wahlin, H. B., and Wilson, P. W. Detection of nitrogen fixation with isotopic nitrogen. J. Biol. Chem., 1943, 148: 349-357. Abstracted in: Chem. Abstr., 1943, 37: 4422.
- 130. Ratner, S., Weissman, N., and Schoenheimer, R. Metabolism of d-lysine investigated with deuterium and heavy nitrogen. J. Biol. Chem., 1943, 147: 549-556. Abstracted in: Chem. Abstr., 1943, 37: 3156.

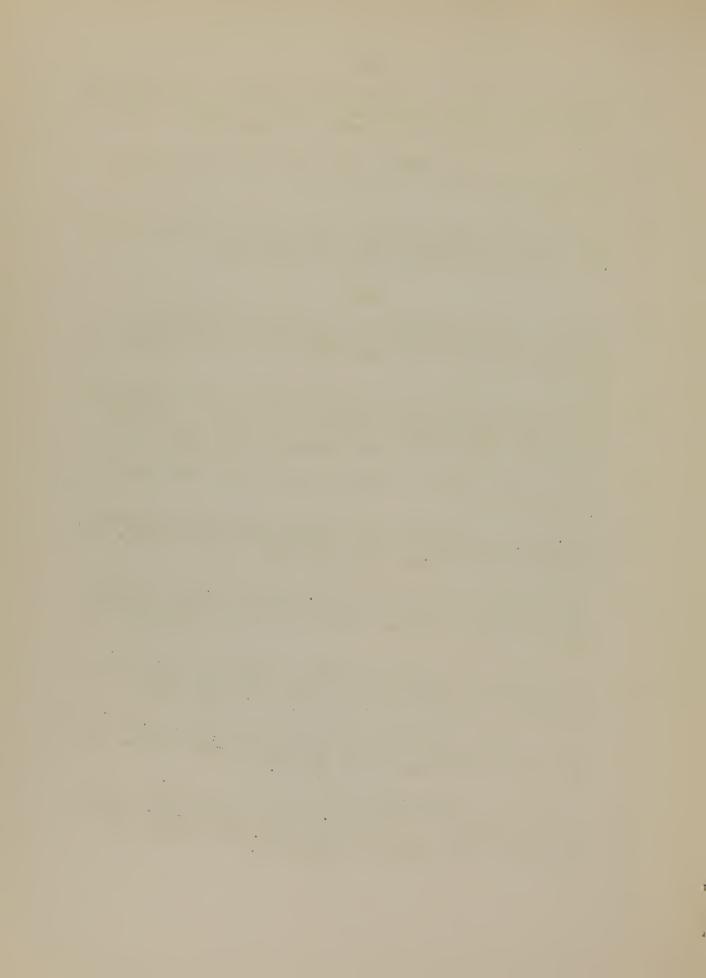
- 131. Bovarnic, M. The formation of extracellular d-glutamic acid polypeptide by Bacillus subtilis. J. Biol. Chem., 1942, 145: 415-424.

 N15 is used as a tracer. Abstracted in: Chem. Abstr., 1943, 37: 901.
- 132. Burris, R. H. Distribution of isotopic nitrogen in Azotobacter vinelandii. J. Biol. Chem., 1942, 143: 509-517. Abstracted in: Chem. Abstr., 1942, 36: 4149.
- 133. Chaikoff, I. I. The application of labeling agents to the study of phospholipide metabolism. Physiol. Rev.; 1942, 22: 291-317. Abstracted in: Chem. Abstr., 1943, 37: 1758.



- 134. Chargaff, E., Ziff, M., and Rittenberg, D. Study of the nitrogenous constituents of tissue phosphatides. J. Biol. Chem., 1942, 144: 343-352. Abstracted in: Chem. Abstr., 1942, 36: 6174.
- 135. Kritzman, M. G., and Konikova, A. S. [The use of heavy isotopes of hydrogen and nitrogen in biochemistry.] Usp. sovrem. biol., 1942, 15: 27-47.
- 136. Stetten, D., Jr. Fate of dietary serine in the body of the rat. J. Biol. Chem., 1942, 144: 501-506. Serine containing N15 was fed to rats. Abstracted in: Chem. Abstr., 1942, 36: 5865.

- 137. Bloch, K., and Schoenheimer, R. The biological precursors of creatine. J. Biol. Chem., 1941, 138: 167-194. 12 different compounds containing N15 were used. Abstracted in: Chem. Abstr., 1941, 35: 2584.
- 138. Bloch, K., Schoenheimer, R., and Rittenberg, D. Rate of formation and disappearance of body creatine in normal animals. J. Biel. Chem., 1941, 138: 155-166. Creatine preparations containing N15 were used. Abstracted in: Chem. Abstr., 1941, 35: 2584.
- 139. Burris, R. H. Failure of barley to fix molecular N15. Science, 1941, 94: 238-239.
- 140. Burris, R. H., and Miller, C. E. Application of N15 to the study of biological nitrogen fixation. Science, 1941, 93: 114-115. Abstracted in: Chem. Abstr., 1941, 35: 3021.
- 141. Chargaff, E., Ziff, M., and Rittenberg, D. Determination of the bases of phospholipides by the isotope-dilution method. J. Biol. Chem., 1941, 138: 439-440. Abstracted in: Chem. Abstr., 1941, 35: 2951.
- 142. Rittenberg, D. The state of proteins in animals as revealed by the use of isotopes. Sympos. Quant. Biol., Cold Spring Harbor, 1941, 9: 283-289. Abstracted in: Chem. Abstr., 1944, 38: 1019.
- 143. Stetten, D., Jr. Biological relationships of choline, ethanolamine and related compounds. J. Biol. Chem., 1941, 138: 437-438. Abstracted in: Chem. Abstr., 1941, 35: 2950.
- 144. Weissman, N., and Schoenheimer, R. Protein metabolism. XV. The relative stability of 1 (+)-lysine in rats studied with deuterium and heavy nitrogen. J. Biol. Chem., 1941, 140: 779-795. Abstracted in: Chem. Abstr., 1941, 35: 7482.



- 145. Hevesy, G., Linderstrøm-Lang, K., Keston, A. S., and Olsen, C. Exchange of nitrogen atoms in the leaves of the sunflower. C. rend. Laborat. Carlsberg, Sér. chim., 1940, 23: 213-218. Abstracted in: Chem. Abstr., 1941, 35: 1835.
- 146. Vickery, H. B., Puncher, G. W., Schoenheimer, R., and Rittenberg, D. The assimilation of ammonia by the tobacco plant: a preliminary study with isotopic nitrogen. J. Biol. Chem., 1940, 135: 531-539.

 Abstracted in: Chem. Abstr., 1940, 34: 7336.

1939

- 147. Bloch, K., and Schoenheimer, R. Protein metabolism. XI. The metabolic relation of creatine and creatinine studied with isotopic nitrogen. J. Biol. Chem., 1939, 131: 111-119. Abstracted in: Chem. Abstr., 1940, 34: 141.
- 148. Vigneaud, V. du; Cohn, M., Brown, G. B., Irish, O. J., Schoenheimer, R., and Rittenberg, D. The inversion of d-phenylaminobutyric acid and the acetylation of l-phenylaminobutyric acid by means of the isotopes of nitrogen and hydrogen. J. Biol. Chem., 1939, 131: 273-296. Abstracted in: Chem. Abstr., 1940, 34: 142.

1938

149. Schoenheimer, R., Rittenberg, D., Foster, G. L., Keston, A. S., and Ratner, S. Application of the nitrogen isotope N15 for the study of protein metabolism. Science, 1938, 88: 599-600. Abstracted in: Chem. Abstr., 1939, 33: 2157.

1937

150. Schoenheimer, R., Rittenberg, D., Fox, M., Keston, A. S., and Ratner, S. Nitrogen isotope (N15) as a tool in the study of the intermediate metabolism of nitrogenous compounds. J. Am. Chem. Soc., 1937, 59: 1768. Abstracted in: Chem. Abstr., 1937, 31: 7983.

